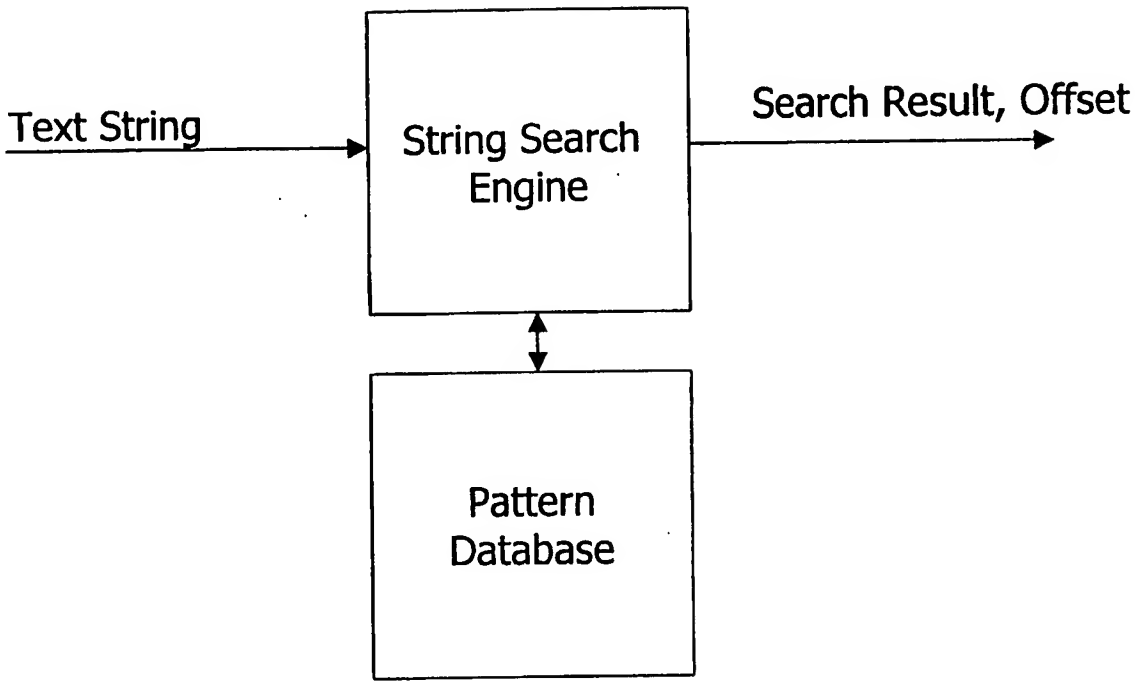

Text String
String Search Engine
Search Result, Offset
Pattern Database

FIG. 1

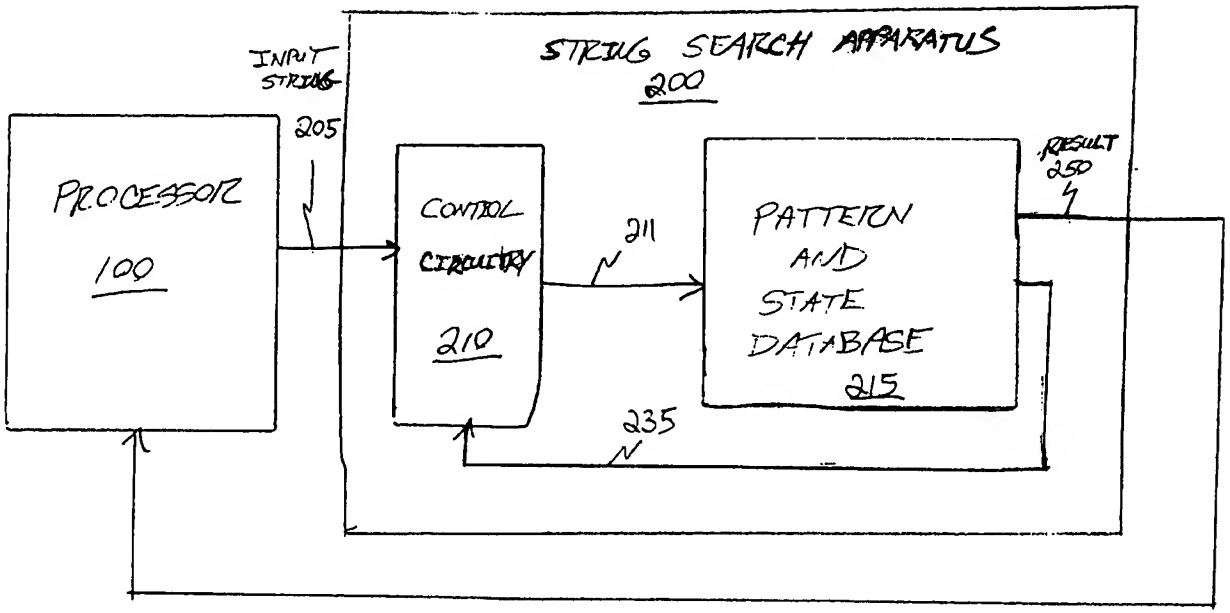

STRING SEARCH APPARATUS
200
INPUT STRING
205
PROCESSOR
100
CONTROL CIRCUITRY
210
211
PATTERN AND STATE DATABASE
215
RESULT
250
235

FIG. 2A

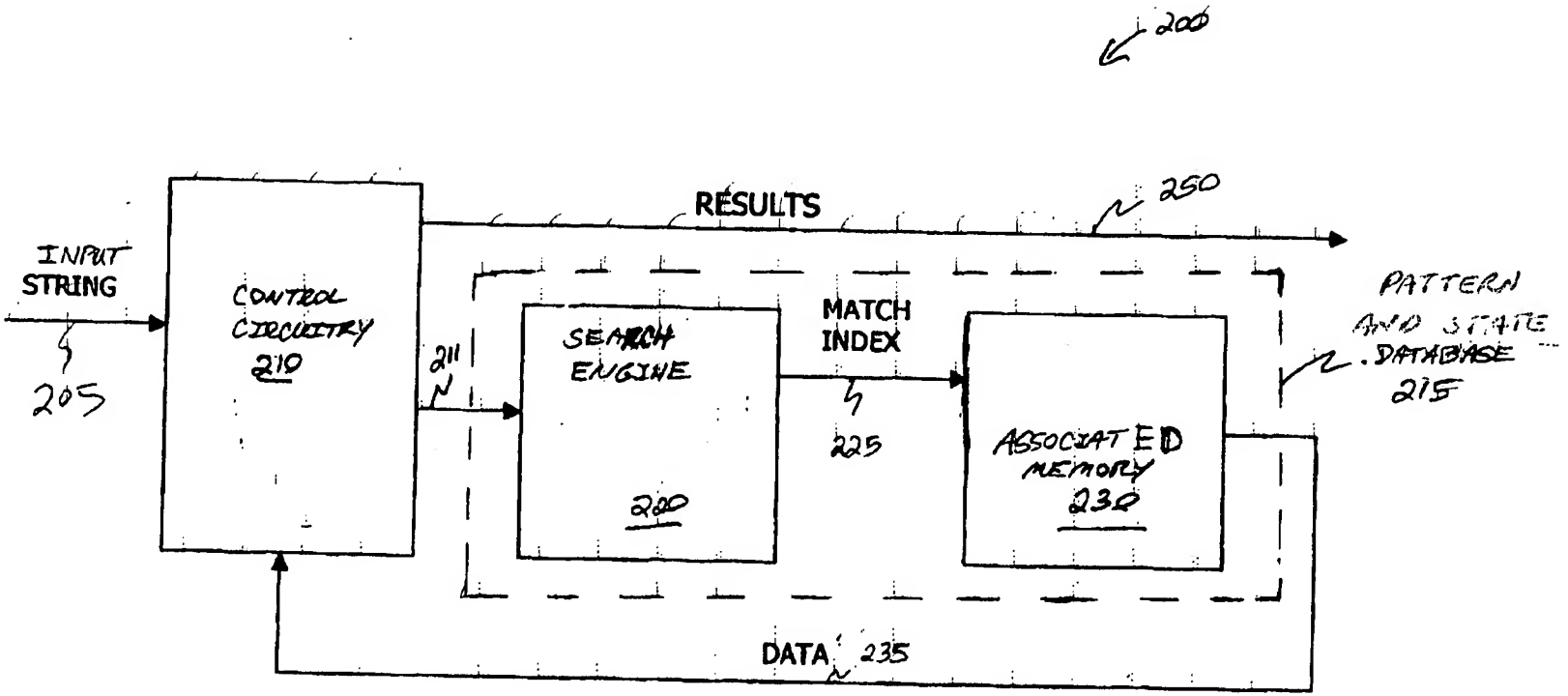
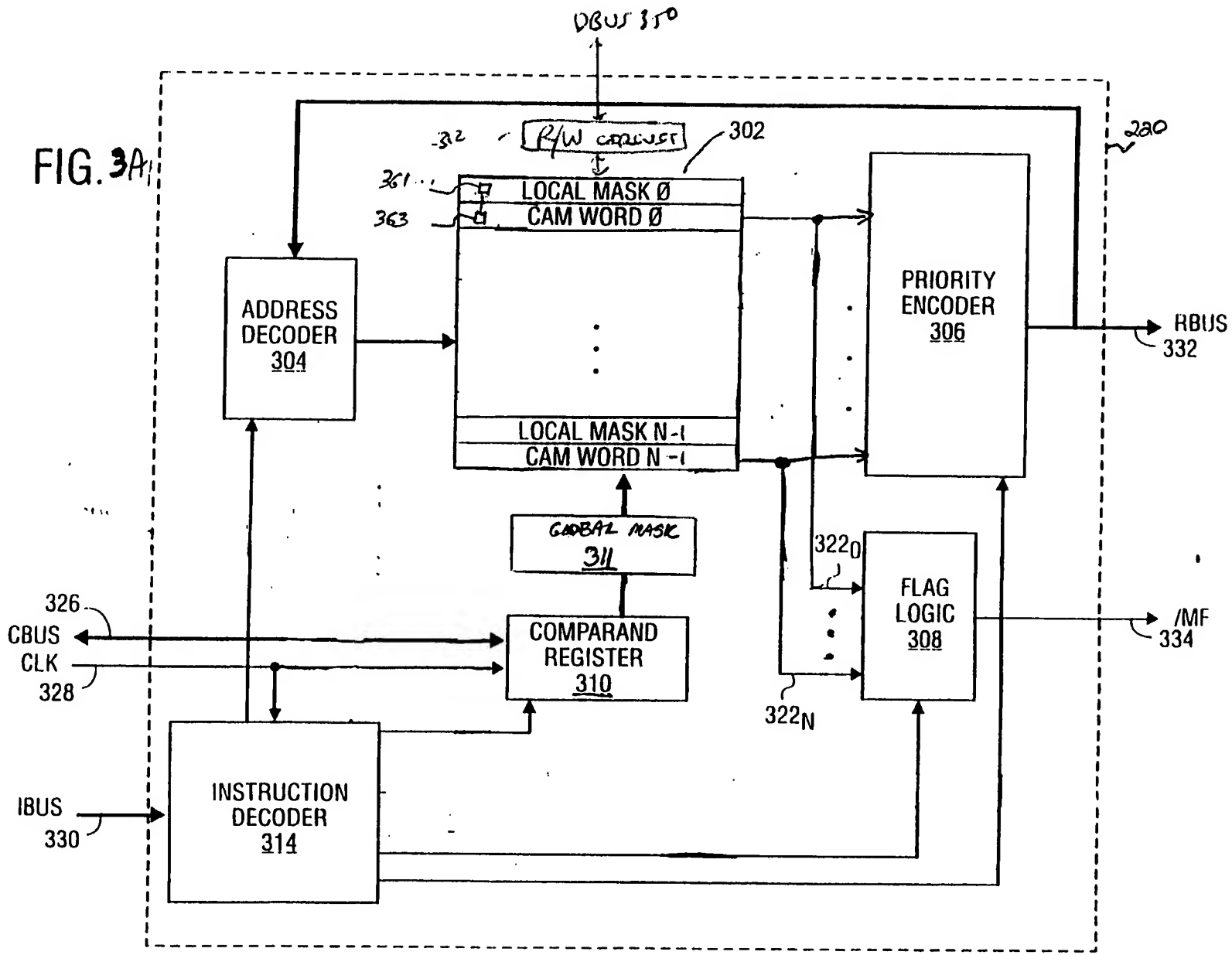

200
INPUT STRING
205
CONTROL CIRCUITRY
210
211
N
SEARCH ENGINE
220
MATCH INDEX
225
ASSOCIATED MEMORY
230
RESULTS
250
PATTERN AND STATE DATABASE
215
DATA
235

FIG. 2B

FIG. 3A


DBUS 350
280
R/W CONTROL
302
361
363
LOCAL MASK Ø
CAM WORD Ø
ADDRESS DECODER 304
LOCAL MASK N-1
CAM WORD N-1
PRIORITY ENCODER 306
RBUS 332
GLOBAL MASK 311
322_0
FLAG LOGIC 308
/MF 334
326
CBUS
CLK
328
COMPARAND REGISTER 310
322_N
IBUS 330
INSTRUCTION DECODER 314

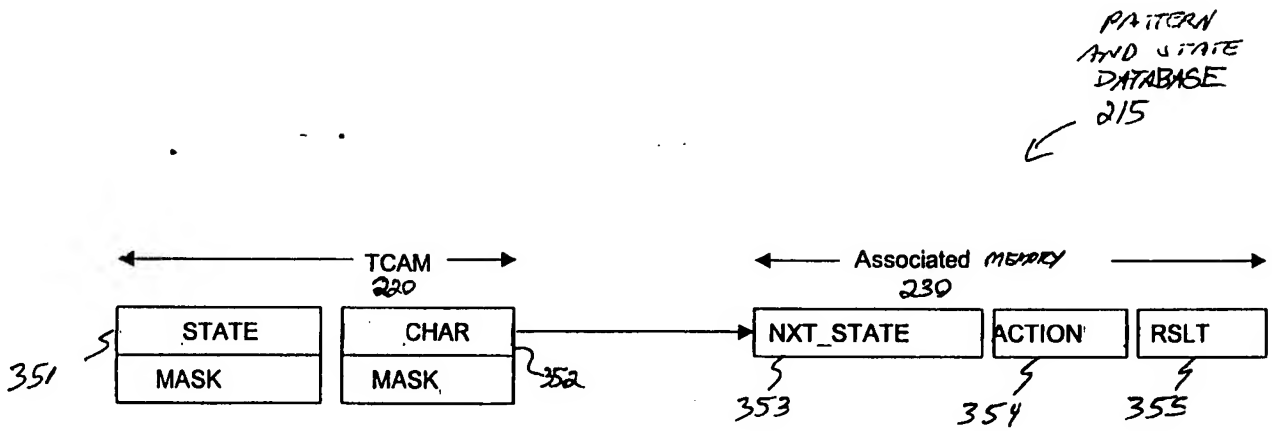

PATTERN AND STATE DATABASE
215
TCAM
220
Associated MEMORY
230
STATE
MASK
CHAR
MASK
NXT_STATE
ACTION
RSLT
351
352
353
354
355

FIG. 3B

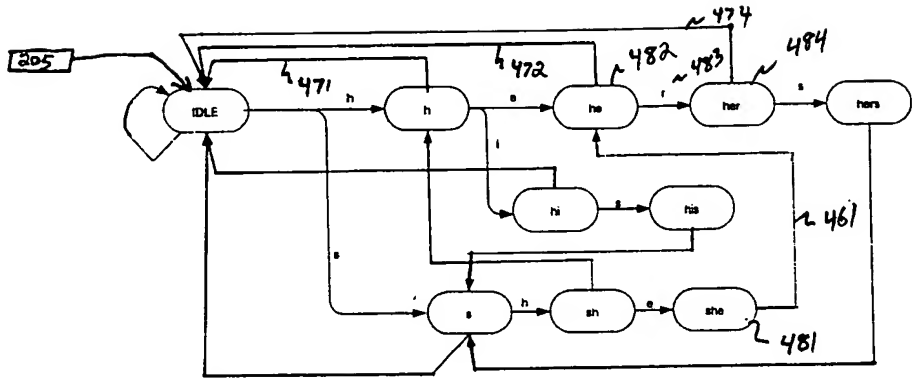
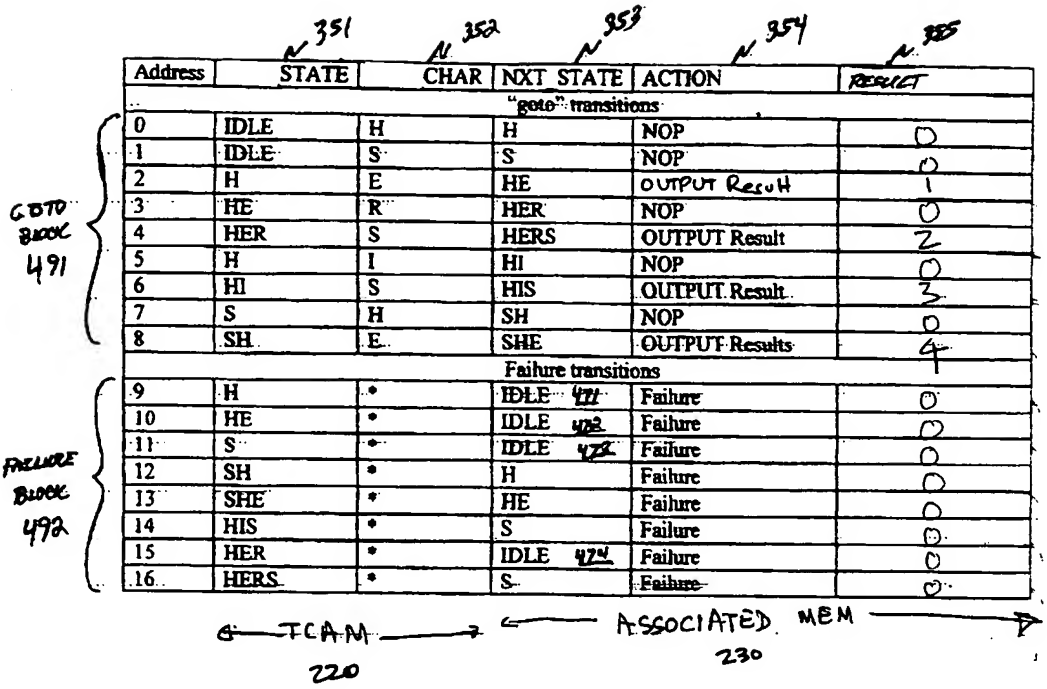

205
IDLE
h
i
s
he
her
hers
hi
his
sh
she
474
471
472
482
483
484
461
481

FIG. 4A



	Address	STATE (351)	CHAR (352)	NXT STATE (353)	ACTION (354)	REJECT (355)
				"goto" transitions		
GOTO BLOCK 491	0	IDLE	H	H	NOP	0
	1	IDLE	S	S	NOP	0
	2	H	E	HE	OUTPUT Result	1
	3	HE	R	HER	NOP	0
	4	HER	S	HERS	OUTPUT Result	2
	5	H	I	HI	NOP	0
	6	HI	S	HIS	OUTPUT Result	3
	7	S	H	SH	NOP	0
	8	SH	E	SHE	OUTPUT Results	4
				Failure transitions		
FAILURE BLOCK 492	9	H	*	IDLE 471	Failure	0
	10	HE	*	IDLE 472	Failure	0
	11	S	*	IDLE 473	Failure	0
	12	SH	*	H	Failure	0
	13	SHE	*	HE	Failure	0
	14	HIS	*	S	Failure	0
	15	HER	*	IDLE 474	Failure	0
	16	HERS	*	S	Failure	0

TCAM 220 — ASSOCIATED MEM 230

FIG. 4B

PATTERN AND STATE DATABASE 215

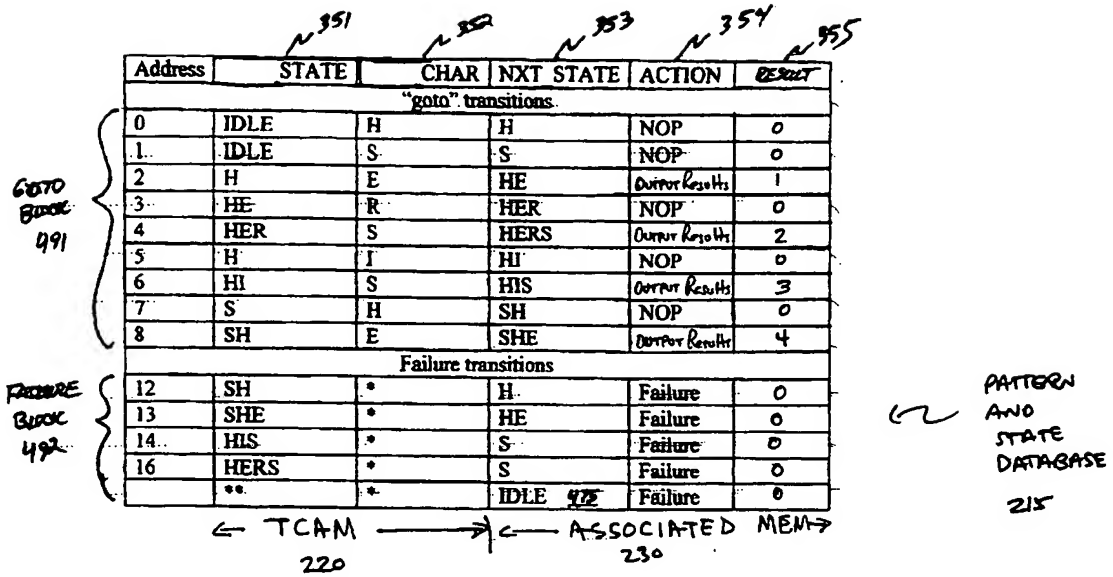

351
352
353
354
355
Address
STATE
CHAR
NXT STATE
ACTION
RESULT
"goto" transitions
0 IDLE H H NOP 0
1 IDLE S S NOP 0
2 H E HE Output Results 1
3 HE R HER NOP 0
4 HER S HERS Output Results 2
5 H I HI NOP 0
6 HI S HIS Output Results 3
7 S H SH NOP 0
8 SH E SHE Output Results 4
Failure transitions
12 SH * H Failure 0
13 SHE * HE Failure 0
14 HIS * S Failure 0
16 HERS * S Failure 0
** IDLE Failure 0
GOTO BLOCK 491
FAILURE BLOCK 492
PATTERN AND STATE DATABASE 215
TCAM 220
ASSOCIATED MEM 230

FIG. 4C

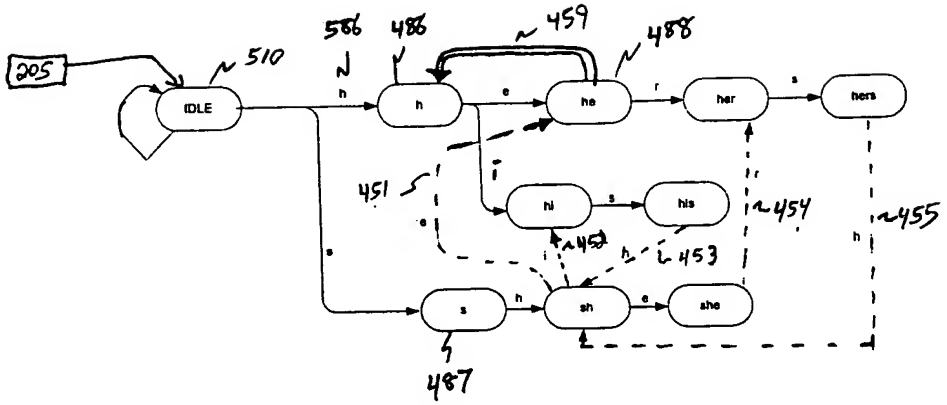

205
510
IDLE
586
486
459
488
h
e
r
s
he
her
hers
451
hi
his
454
455
452
453
sh
she
487

FIG. 5

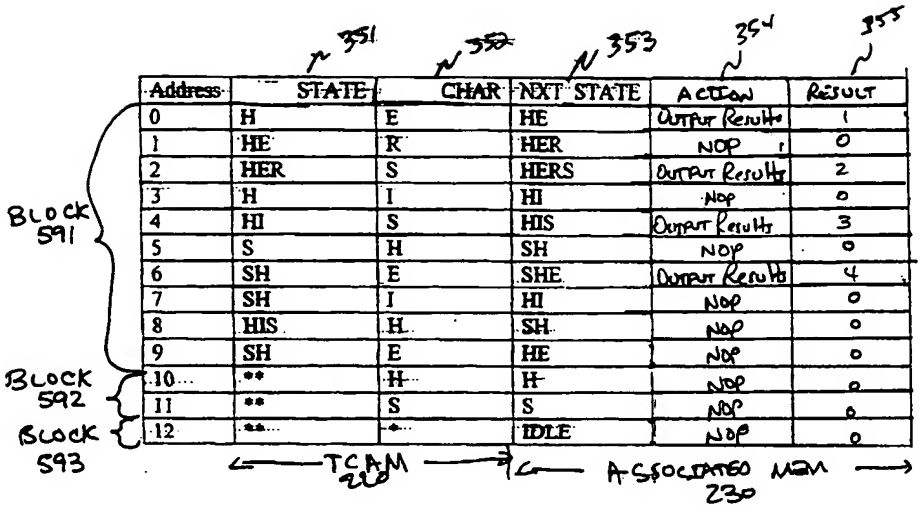


FIG. 6

PATTERN AND STATE DATABASE 215

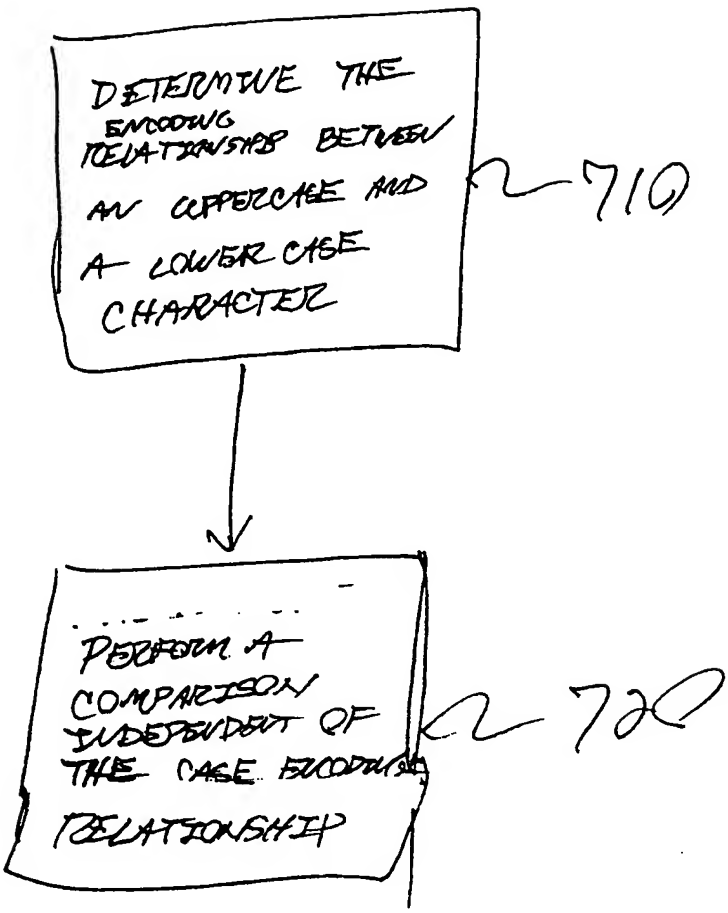
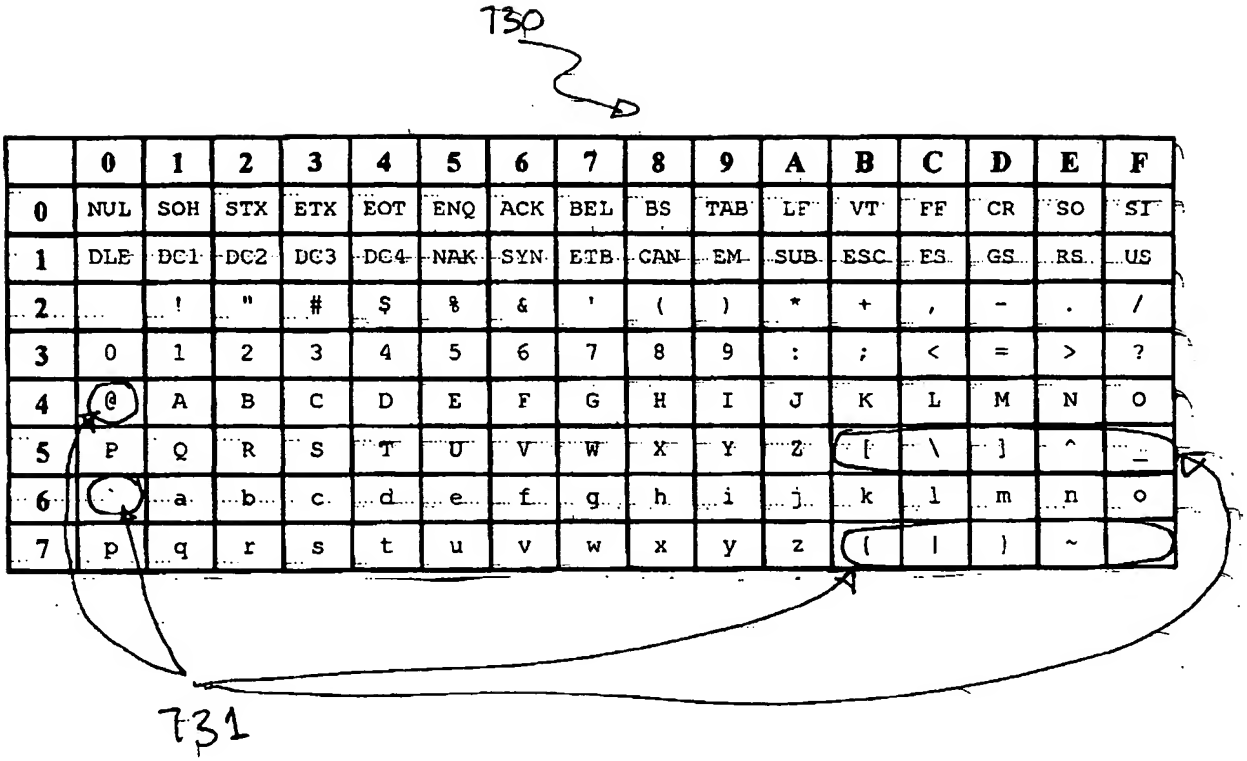

DETERMINE THE ENCODING RELATIONSHIP BETWEEN AN UPPERCASE AND A LOWER CASE CHARACTER
710
PERFORM A COMPARISON INDEPENDENT OF THE CASE ENCODING RELATIONSHIP
720

FIG. 7.



	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	TAB	LF	VT	FF	CR	SO	SI
1	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	ES	GS	RS	US
2		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	

FIG 7A

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	TAB	LF	VT	FF	CR	SO	SI
1	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
2		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z					
6		a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z					
8																
9																
A																
B																
C																
D	@											[	\	]	^	_
E																
F												{	|	}	~	

FIGURE 7C

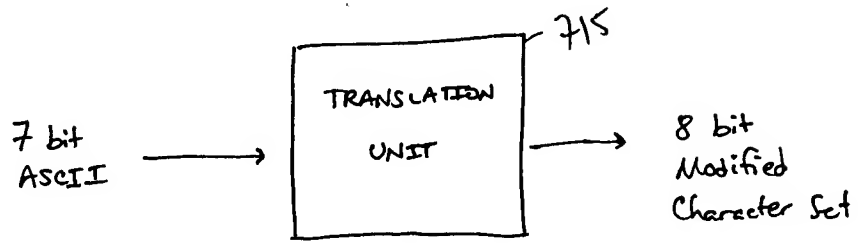


FIG. 7B

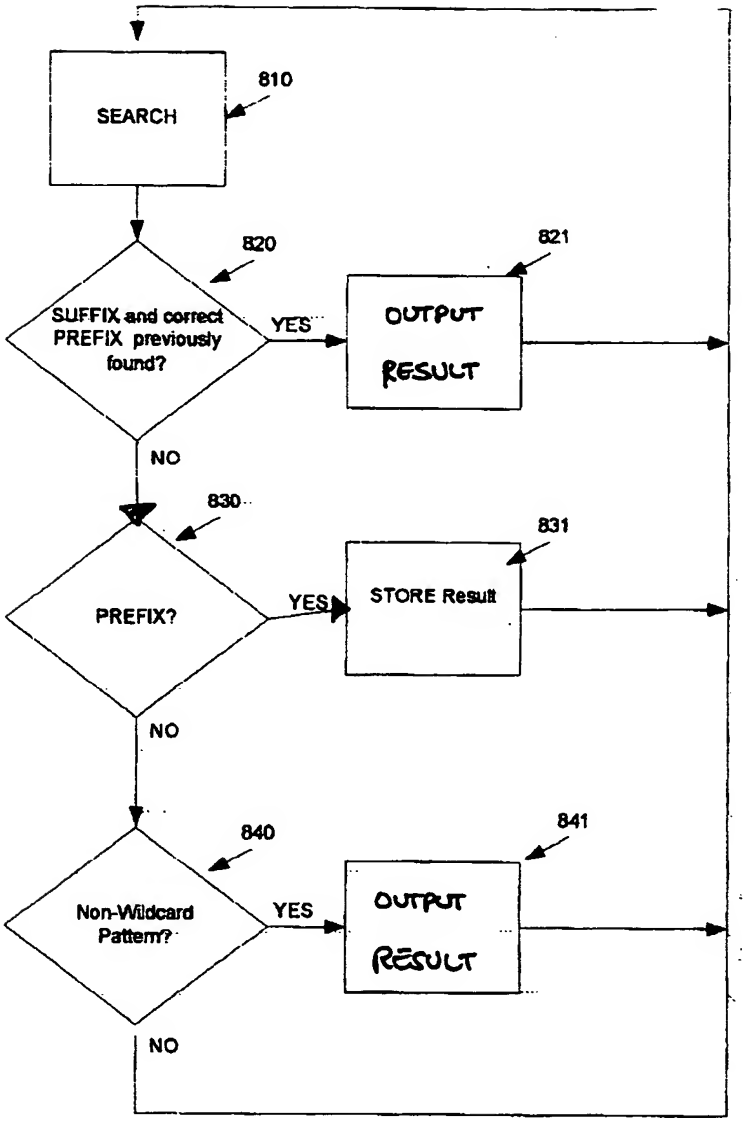

SEARCH
810
820
SUFFIX and correct PREFIX previously found?
YES
821
OUTPUT RESULT
NO
830
PREFIX?
YES
831
STORE Result
NO
840
Non-Wildcard Pattern?
YES
841
OUTPUT RESULT
NO

FIGURE 8A

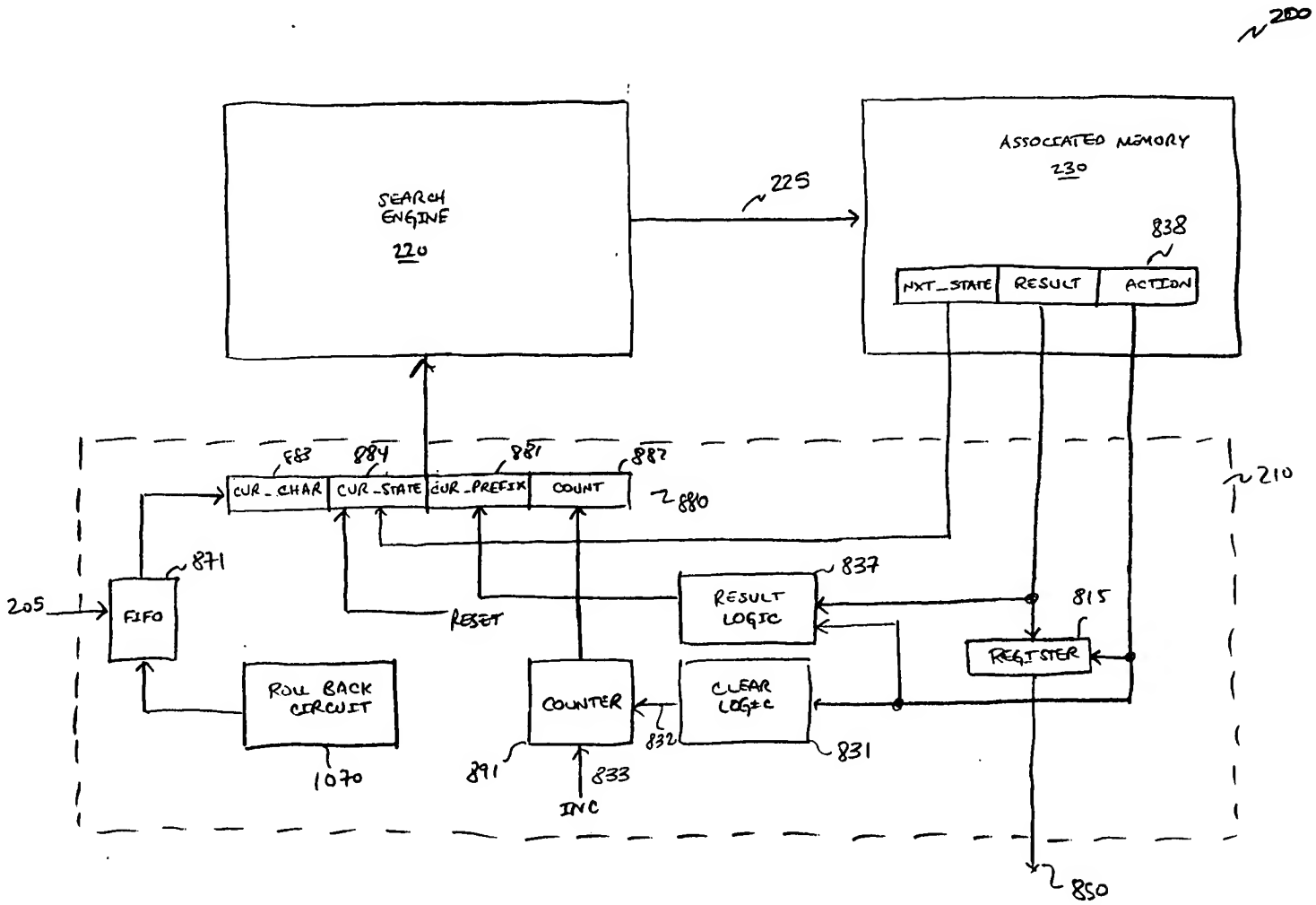

200
SEARCH ENGINE 220
225
ASSOCIATED MEMORY 230
838
NXT_STATE
RESULT
ACTION
210
883
884
881
887
CUR_CHAR
CUR_STATE
CUR_PREFIX
COUNT
880
871
205
FIFO
RESET
837
RESULT LOGIC
815
REGISTER
ROLL BACK CIRCUIT
1070
COUNTER
CLEAR LOGIC
832
831
891
833
INC
850

FIG. 8B

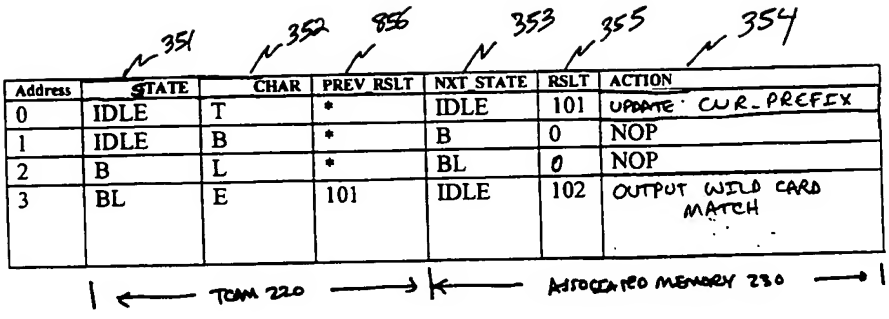

351
352
856
353
355
354
Address
STATE
CHAR
PREV RSLT
NXT STATE
RSLT
ACTION
0
IDLE
T
*
IDLE
101
UPDATE: CUR_PREFIX
1
IDLE
B
*
B
0
NOP
2
B
L
*
BL
0
NOP
3
BL
E
101
IDLE
102
OUTPUT WILD CARD MATCH
TCAM 220
ASSOCIATED MEMORY 230

FIG. 8C

Address	STATE (851)	CHAR (852)	PREV RSLT (856)	COUNT (857)	NXT STATE (853)	RSLT (855)	ACTION (854)
0	IDLE	T	*	0	IDLE	101	UPDATE CUR_PREFIX
1	IDLE	B	*	*	B	0	NOP
2	B	L	*	*	BL	0	NOP
3	BL	E	101	5	IDLE	102	OUTPUT WILD CARD MATCH

← TCAM 210 → | ← ASSOCIATED MEMORY 230 →

FIG 8D

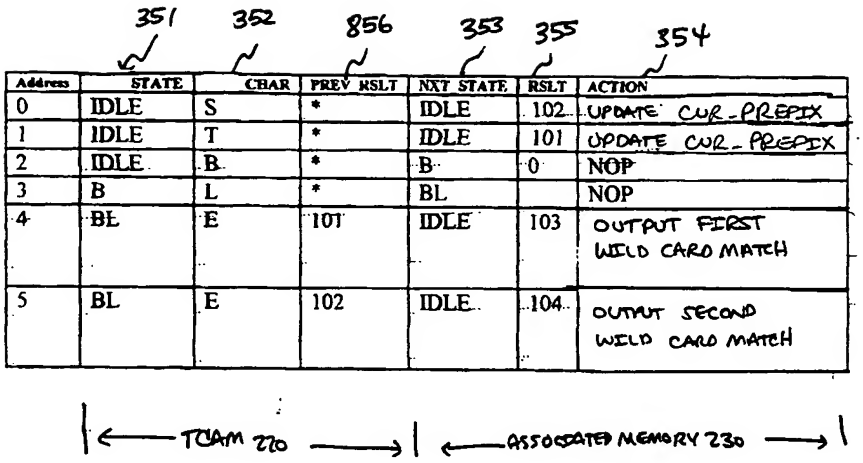

351
352
856
353
355
354
Address
STATE
CHAR
PREV RSLT
NXT STATE
RSLT
ACTION
0
IDLE
S
*
IDLE
102
UPDATE CUR-PREFIX
1
IDLE
T
*
IDLE
101
UPDATE CUR-PREFIX
2
IDLE
B
*
B
0
NOP
3
B
L
*
BL
NOP
4
BL
E
101
IDLE
103
OUTPUT FIRST WILD CARD MATCH
5
BL
E
102
IDLE
104
OUTPUT SECOND WILD CARD MATCH
TCAM 210
ASSOCIATED MEMORY 230

FIG. 8E

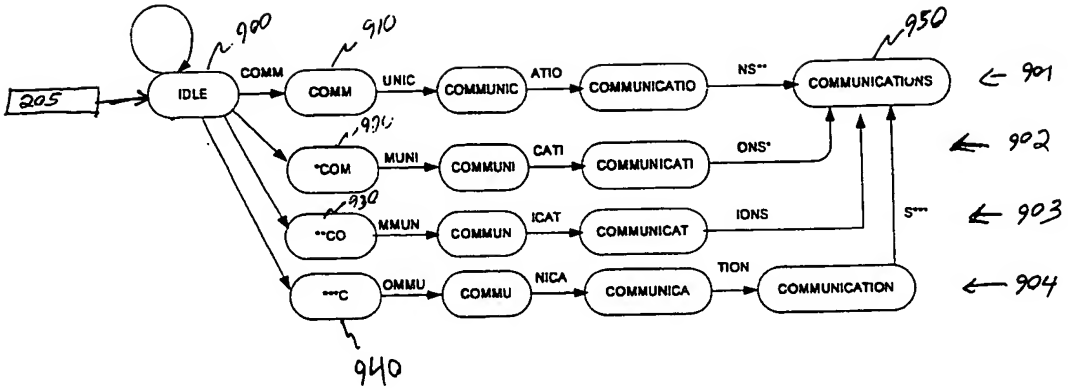

205
IDLE
900
COMM
910
UNIC
ATIO
NS**
950
COMMUNICATIONS
901
"COM
MUNI
CATI
ONS*
902
**CO
MMUN
ICAT
IONS
S***
903
***C
OMMU
NICA
TION
904
940

FIG. 9A

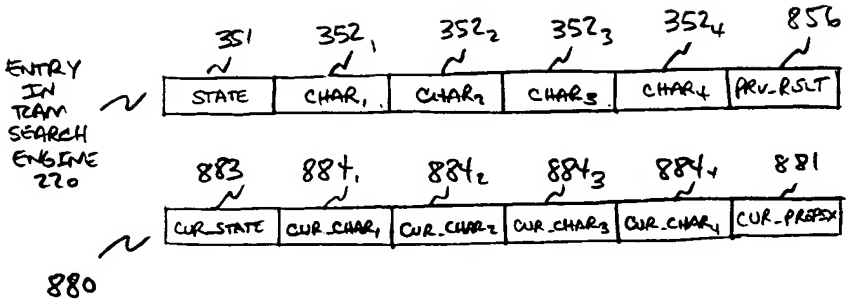

351
352₁
352₂
352₃
352₄
856
ENTRY IN TRAM SEARCH ENGINE 220
STATE
CHAR₁
CHAR₂
CHAR₃
CHAR₄
PRV_RSLT
883
884₁
884₂
884₃
884₄
881
CUR_STATE
CUR_CHAR₁
CUR_CHAR₂
CUR_CHAR₃
CUR_CHAR₄
CUR_PREFIX
880

FIG. 9B

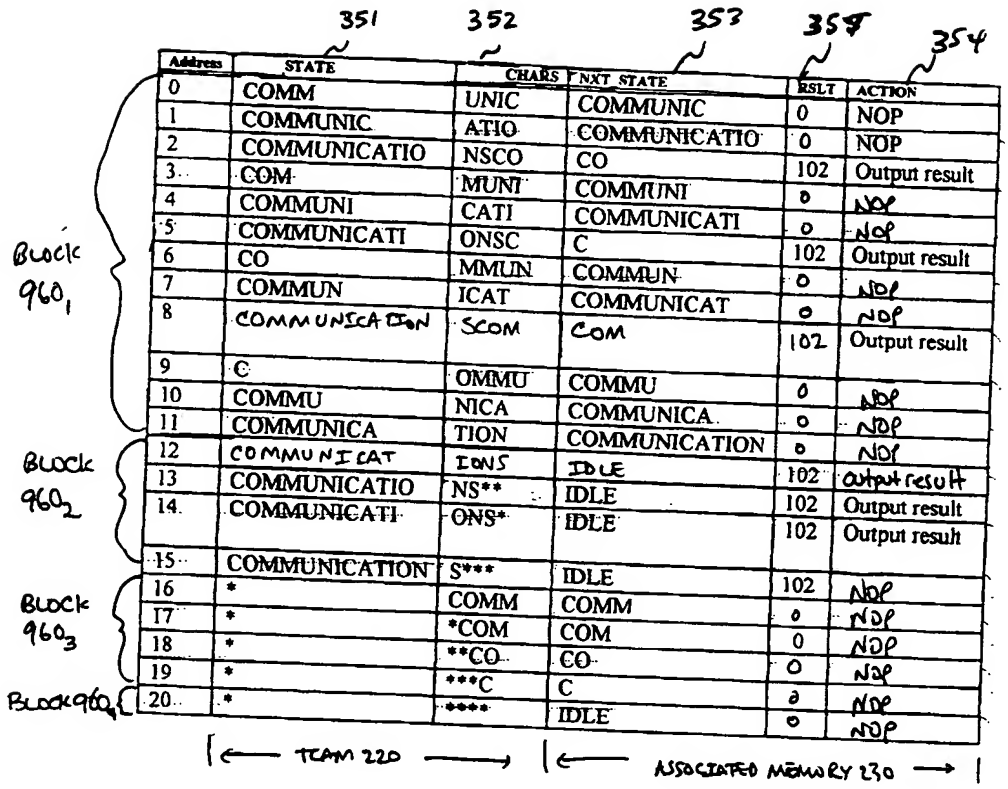

351
352
353
354
Address
STATE
CHARS
NXT STATE
RSLT
ACTION
0 COMM UNIC COMMUNIC 0 NOP
1 COMMUNIC ATIO COMMUNICATIO 0 NOP
2 COMMUNICATIO NSCO CO 102 Output result
3 COM MUNI COMMUNI 0 NOP
4 COMMUNI CATI COMMUNICATI 0 NOP
5 COMMUNICATI ONSC C 102 Output result
6 CO MMUN COMMUN 0 NOP
7 COMMUN ICAT COMMUNICAT 0 NOP
8 COMMUNICATION SCOM COM 102 Output result
9 C OMMU COMMU 0 NOP
10 COMMU NICA COMMUNICA 0 NOP
11 COMMUNICA TION COMMUNICATION 0 NOP
12 COMMUNICAT IONS IDLE 102 Output result
13 COMMUNICATIO NS** IDLE 102 Output result
14 COMMUNICATI ONS* IDLE 102 Output result
15 COMMUNICATION S*** IDLE 102 NOP
16 * COMM COMM 0 NOP
17 * *COM COM 0 NOP
18 * **CO CO 0 NOP
19 * ***C C 0 NOP
20 * **** IDLE 0 NOP
Block 960₁
Block 960₂
Block 960₃
Block 960₄
TCAM 220
ASSOCIATED MEMORY 230

FIG 9C.

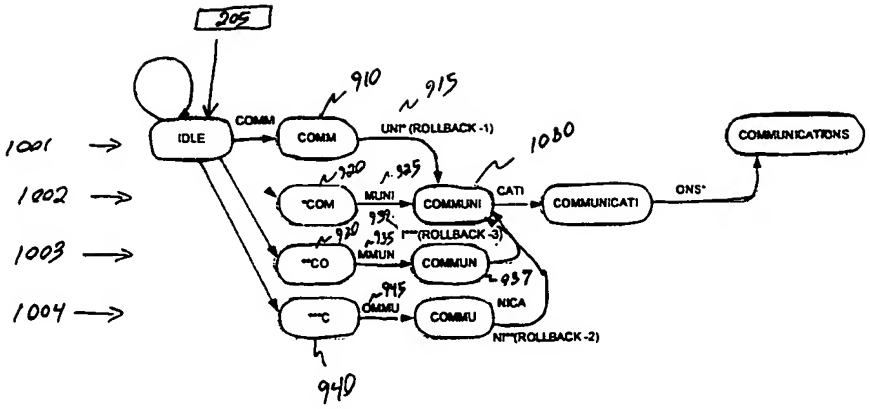

205
910
915
1001
IDLE
COMM
COMM
UNI" (ROLLBACK -1)
1080
COMMUNICATIONS
1002
920
925
"COM
MUNI
COMMUNI
CATI
COMMUNICATI
ONS"
932
930
935
(ROLLBACK -3)
1003
"CO
MMUN
COMMUN
937
945
1004
"C
OMMU
COMMU
NICA
NI"(ROLLBACK -2)
940

FIG. 10A

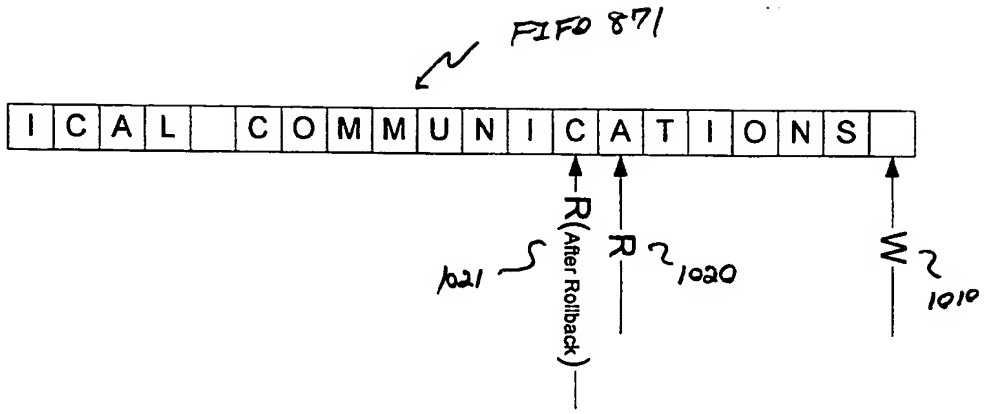

FIFO 871
I C A L C O M M U N I C A T I O N S
R (After Rollback)
1021
R
1020
W
1010

FIG. 10B

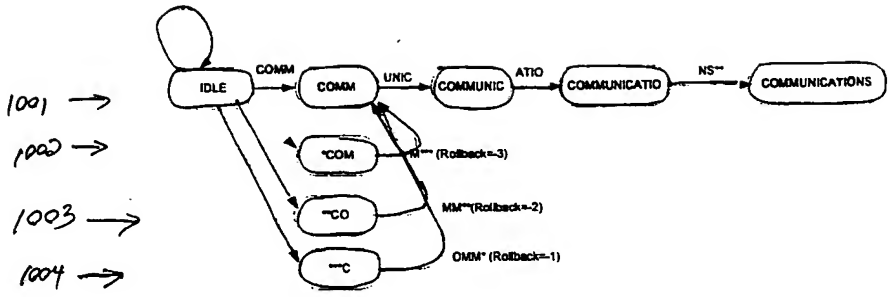

1001
1002
1003
1004
IDLE
COMM
COMM
UNIC
COMMUNIC
ATIO
COMMUNICATIO
NS**
COMMUNICATIONS
*COM
M*** (Rollback=-3)
**CO
MM**(Rollback=-2)
***C
OMM* (Rollback=-1)

FIG. 10C

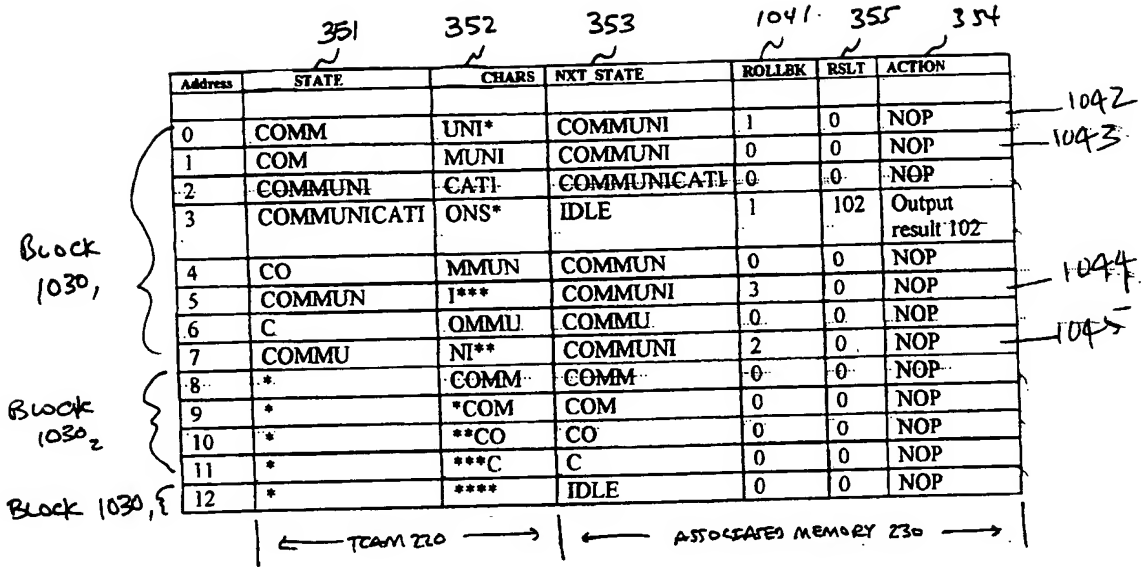

351
352
353
1041
355
354
Address
STATE
CHARS
NXT STATE
ROLLBK
RSLT
ACTION
0 COMM UNI* COMMUNI 1 0 NOP
1 COM MUNI COMMUNI 0 0 NOP
2 COMMUNI CATI COMMUNICATI 0 0 NOP
3 COMMUNICATI ONS* IDLE 1 102 Output result 102
4 CO MMUN COMMUN 0 0 NOP
5 COMMUN I*** COMMUNI 3 0 NOP
6 C OMMU COMMU 0 0 NOP
7 COMMU NI** COMMUNI 2 0 NOP
8 * COMM COMM 0 0 NOP
9 * *COM COM 0 0 NOP
10 * **CO CO 0 0 NOP
11 * ***C C 0 0 NOP
12 * **** IDLE 0 0 NOP
1042
1043
1044
1045
Block 1030,
Block 1030,
Block 1030,
TCAM 220
ASSOCIATED MEMORY 230

FIG. 10D

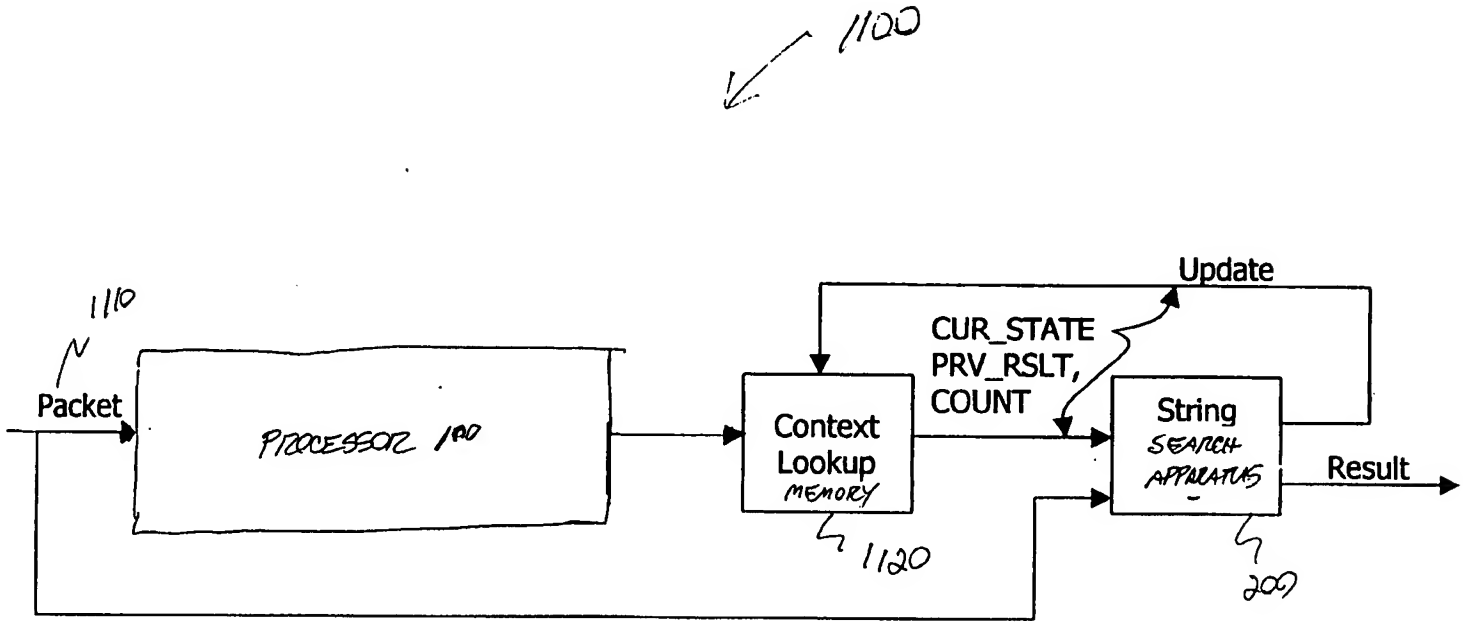

1100
1110
Packet
PROCESSOR 100
Context Lookup MEMORY
1120
CUR_STATE
PRV_RSLT,
COUNT
Update
String SEARCH APPARATUS
209
Result

FIG. 11